Aqua Link, Inc.
Pond, Lake & Stream Management & Supplies

March 18, 2022

Walker Lake Landowners Association
Shohola Township
Pike County, Pennsylvania

Re: Walker Lake
Aquatic Macrophyte Survey Final Report
ALI Project No. 1577-25

Dear Board Members:

Aqua Link was retained by the Walker Lake Landowners Association (hereinafter referred to as the Association) to perform a follow-up aquatic macrophyte (vascular plant) survey of Walker Lake early in the 2021 growing season. Located off Twin Lakes Road in Shohola Township, Pennsylvania, Walker Lake has a surface area of approximately 110 acres.

The purpose of this aquatic plant survey was to document the different aquatic plant species (native and non-native) and their respective densities throughout the entire lake basin in 2021 as compared to the previous macrophyte surveys performed by Aqua Link during the 2017-2020 seasons. Native aquatic plants are an integral component of balanced lake ecosystems and provide important aquatic habitats for numerous aquatic organisms including fish. In contrast, non-native, invasive aquatic plants can upset this delicate balance and outcompete native species, which are often less problematic. Once established, the control or eradication of non-native, invasive aquatic plants can be very expensive, therefore the early detection of non-native, invasive aquatic plants is an essential component of lake management plans.

Variable leaf milfoil (*Myriophyllum heterophyllum*) was discovered for the first time in Walker Lake during the 2020 survey. Variable leaf milfoil is a non-native, highly invasive plant that has several modes of reproduction and can quickly out-compete other plant species if left untreated. Unfortunately, this highly invasive species was once again observed during the 2021 macrophyte survey. Moving forward, managing and eradicating this plant will be of utmost importance. While native bladderwort (*Utricularia sp.*) remains present in the lake, herbicide treatments have reduced the population of this species to densities that may be considered beneficial to the lake ecosystem. However, herbicide treatments should continue to be aggressive for both of these species moving forward as they both proliferate quickly when left unchecked.

This document represents the final report for the aquatic macrophyte survey, performed by Aqua Link in late May 2021. Section 1 of this report discusses our study design, all methods used to collect field data, and how these data were analyzed. Section 2 represents the results of the aquatic plant survey. Section 3 provides a trend analysis comparing the 2017-2021 plant data.

P.O. Box 605, Doylestown, PA 18901-0605
Phone: 215.230.9325 • • • Fax: 215.230.9326 • • • Website: www.aqualinkinc.com

Section 4 discusses our conclusions and our recommendations to control nuisance, problematic aquatic vegetation and to further protect the lake in terms of water quality.

1. Study Design, Field Methods & Data Analysis

Study Design & Field Methods

Aqua Link performed the fifth aquatic macrophyte (aquatic plant) survey of Walker Lake on May 26, 2021 to determine changes in the macrophyte community following plant treatments performed during the 2020 season. The aquatic plant survey was performed by a 2-man field crew using a 16-ft boat equipped with an outboard motor and Lowrance water depth chart plotter (fathometer or water depth sounder).

For this study, aquatic vegetation (floating leaved and submerged) was sampled at 31 different locations throughout the lake along predetermined transects. These locations were the same lake locations that were sampled during the previous surveys. The locations of all sampling points were determined using a Garmin GPS unit (Montana 680t model) for this aquatic plant survey.

At each lake sampling point, the aquatic plant community was observed and documented. Aquatic plants at the lake surface in reach of the boat were collected by hand for field identification. Next, submerged aquatic vegetation was sampled using an aquatic rake. The aquatic rake was lowered to the lake bottom and dragged a distance of approximately 1 meter (3.3 feet) on each side of the boat. Collected aquatic plants were sorted in the boat and identified. In addition, Aqua Link recorded the relative densities (low, moderate, and high) of all aquatic plants that were collected at each of the sampling locations. Aqua Link also retained representative specimens of all vegetation collected during the macrophyte survey. All retained plant specimens were packaged and transported back to our laboratory. All identification of collected plant specimens were then verified by a second Aqua Link professional lake manager.

For this report, Section 2 contains a discussion on the threat that variable leaf milfoil poses to the ecosystem and recreational activities. A more in-depth analysis can be found in Section 3, comparing the macrophyte species of concern and how the macrophyte community has evolved over the years. Other species of potential concern include floating aquatic vegetation like watershield and both white and yellow water lily. However, these species are not considered a nuisance or threat at this time in the lake at their respective densities. Other macrophyte species that were identified in the 2021 survey are not considered a threat to the health of the lake or recreational activities and are considered beneficial to the aquatic ecosystem at their respective densities.

Data Analysis

Aqua Link initially developed an aquatic plant survey database for this project using Microsoft Excel in 2017. All newly acquired plant data (e.g. plant identifications, relative densities and GPS locations) for 2021 were entered into the existing database for analysis. GPS data and Google Earth mapping software were used to develop aquatic macrophyte coverage maps for the 2017 - 2021 study years.

Figure 1 Aquatic Plant Sampling Locations at Walker Lake

2. Aquatic Macrophyte Survey Results

Aqua Link performed a macrophyte (aquatic plant) survey of Walker Lake on May 26, 2021. The study design, methods, and data analysis for this aquatic macrophyte survey were previously discussed in Section 1. All field data collected as part of this survey are presented in Attachment A of this report.

A total of 31 individual points were sampled at Walker Lake in 2021. A total of ten (10) different aquatic macrophyte species were identified during the May 2021 survey (Table 1). The vegetation type for each identified specimen is also provided in Table 1. Macrophyte types were designated as submerged aquatic vegetation (SAV), macro-algae (MA), or floating leaved aquatic vegetation (FAV). Refer to Attachment B for background information on the aquatic vegetation species that were collected for the 2017 through 2021 study dates.

The most prevalent species found in Walker Lake in 2021 were stonewort (*Nitella sp.*) and water moss (*Fontinalis antipyretica*). Stonewort was found in 27 of the 31 sampling locations in low densities while water moss was found in 11 of the 31 sample locations, also in low densities. Bladderwort (*Utricularia sp.)* and yellow water lily (*Nuphar lutea)* were the next most prevalent species found, both existing 7 of the 31 sampling locations in low densities. All other species were found in 4 or less sampling locations in low densities. Variable leaf milfoil *(Myriophyllum heterophyllum)* was found with low density at only 1 location.

Table 1 Aquatic Plants in Walker Lake in 2021

Common Name	*Scientific Name*	*Plant Type*
Bladderwort	***Utricularia sp.***	**SAV**
Giant Hairgrass	***Eleocharis montevidensis***	**SAV**
Stonewort	***Nitella sp.***	**MA**
Water Shield	***Brasenia schreberi***	**FAV**
Yellow Water Lily	***Nuphar lutea***	**FAV**
Leafy Pondweed	***Potomogetan foliosis***	**SAV**
Springtape	***Sagittaria kurziana***	**SAV**
Water Moss	***Fontinalis antipyretica***	**SAV**
White Water Lily	***Nymphaea sp.***	**FAV**
Variable Leaf Milfoil	***Myriophyllum heterophyllum***	**SAV**

In 2021, 10 different species of macrophytes were found. Bladderwort was found in 7 different sampling locations, primarily in the middle to the north-eastern regions of the lake in 2021. Floating aquatic vegetation was found in 10 locations this year, an increase from a total of 4 locations in 2020. Floating aquatic vegetation is still not considered a nuisance at this time at the respective frequency and density. It should be noted that the mature form of Stonewort, also known as *nitella*, was thought to be a different but very similar species, muskgrass, during previous surveys. Mature forms of stonewort very closely resemble muskgrass due to the similar physical characteristics. However, after thorough research, it was determined that what was once

thought to be muskgrass in previous surveys was actually mature stonewort. While they look very similar, stonewort has a slightly more translucent green color with less rigid branches and prefers more acidic water. Stonewort is a native species and is considered beneficial to the ecosystem at its respective frequency and density. The highly invasive variable leaf milfoil was once again detected at one location during the 2021 survey. However, it should be noted that during the 2021 fishery survey performed on November 11, 2021 variable leaf milfoil was observed in several different locations throughout the lake in low to moderate densities.

With the exceptions of springtape, baby tears, and variable leaf milfoil, all other aquatic plants identified during the 2017 through 2021 aquatic plant surveys and other site visits were considered native. Native species present in the lake are currently considered beneficial at their respective frequencies and densities.

In all five surveys, springtape was not considered problematic, but should continue to be monitored. Similarly, baby tears was not problematic when observed during a lake monitoring event in 2016, but monitoring should continue to prevent potential spread of this species. While variable leaf milfoil is not currently considered problematic at its low to moderate density and frequency, its presence poses a threat to the lake ecosystem and recreational activities in the future as this plant can reproduce rapidly if left untreated. It will be extremely important to monitor and eradicate this plant before it becomes problematic in the lake.

Figure 1 shows all of the sampling point locations used by Aqua Link during the 2017 – 2021 aquatic plant surveys. Figures 2 and 3 depict the distribution of bladderwort in 2020 and 2021. Figures 4 and 5 present the distribution of floating leaved aquatic vegetation (FAV) in 2020 and 2021. Figures 6 and 7 illustrate the distribution of variable leaf milfoil in 2020 and 2021, respectively.

Figure 2 Bladderwort Distribution in Walker Lake in 2020

Figure 3 Bladderwort Distribution in Walker Lake in 2021

Figure 4 Floating Aquatic Vegetation Distribution in Walker Lake 2020

Figure 5 Floating Aquatic Vegetation Distribution in Walker Lake 2021

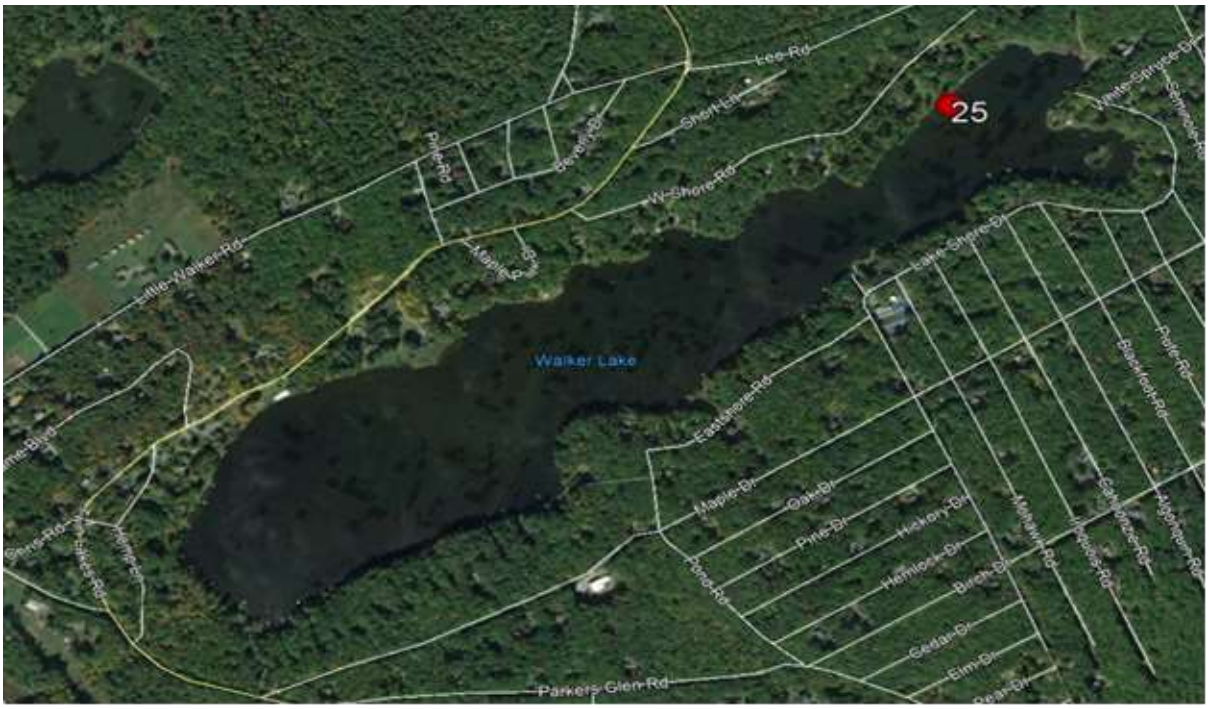

Figure 6 Variable Leaf Watermilfoil Distribution in Walker Lake 2020

Figure 7 Variable Leaf Watermilfoil Distribution in Walker Lake 2021

In 2021, bladderwort was found at 7 of the 31 sampling locations in Walker Lake in low densities (Figure 3). For comparison, this plant was found in 14 of the 31 locations in 2020 (Figures 2 & 3). Bladderwort is a carnivorous plant common to Pennsylvania. It is most common in the northeast region of the state in water bodies that exhibit an acidic pH (below 7), a low alkalinity (soft water) and cold average water temperatures. Bladderwort is a submerged, free-floating aquatic plant that lacks true roots. Due to this anatomical feature, nutrients are not obtained via the lake sediment, but rather from the water column. Nutrient uptake via the water column is supplemented with captured microorganisms such as zooplankton, insects, and juvenile crustaceans. Utricles (i.e. small bladders) located at the base of the leaves capture the aforementioned prey. Tiny hair like projections at the opening of the bladder are sensitive to the motion of prey; when stimulated these hairs cause the bladder to suck in water and the passing organism. The bladder is then quickly closed, and the prey is digested.

Bladderwort is a perennial plant that reproduces via seed production, turions (i.e. buds), and fragmentation. A yellow flower protrudes from the water's surface, receives pollen from an insect, then drops a seed. Seeds and turions (buds) lie dormant through the fall and winter season. In the spring, water temperature and sunlight penetration trigger the inflation and subsequent floatation of buds and seeds to the water surface, where a new plant begins to grow. Aside from seeds and buds, fragmentation also results in reproduction. Small leaves, stems, or roots that are broken off begin to sprout and grow into a new plant. Anatomically, bladderwort has finely-divided, branched, submerged leaves, and produces irregular yellow snapdragon-like flowers. Bladderwort provides food and cover for fish. It is especially valuable due to its ability to grow in acidic water bodies with loose sediment where few other aquatic plants will grow.

In 2021, floating aquatic vegetation was found at 10 locations throughout the lake, 6 more locations than 2020. Floating aquatic vegetation consisted of watershield, yellow water lily, and white water lily. While the frequency of floating vegetation increased from 2020 to 2021, each species exists at low densities and are considered beneficial to the ecosystem at their current frequency and densities. All forms of floating aquatic vegetation are considered well under control at this time in regards to both recreational uses of the lake as well as ecologically. When controlled at the proper frequency and density, floating aquatic vegetation provides excellent habitat for fish and many other forms of aquatic life. Small fish hide in the entangled stems of floating vegetation to hide from larger fish and other predators. Large fish use this cover as ambush points for targeting prey, as well as seek refuge in the shade provided by lily pads during hot summer days.

Variable leaf milfoil was once again observed during the 2021 macrophyte survey at one location. This species is a submerged aquatic plant that has feather like leaves whorled around a main stem. The leaves of this plant are highly variable, containing anywhere from 5 to 14 leaflets per leaf and generally there are 4 to 6 leaves per whorl. Stands of this plant can grow to be extremely dense, with stems reaching heights of well over ten feet. Typically this plant flowers

in late June to early July and produces white flowers on an emergent bract. Coloration on the plant is green with a brown to reddish hue on leaf tips. This plant can spread quickly as one of its modes of reproduction is through fragmentation in which pieces of the plant break off and form a new plant. Because of this, it can quickly out-compete native, beneficial forms of vegetation and grow in very dense stands. Variable leaf milfoil can grow to be so dense that it can substantially decrease dissolved oxygen levels and make recreational activities nearly impossible. It was likely introduced as an aquatic hitchhiker on boat equipment or by waterfowl. Its re-emergence in 2021 indicates successful reproduction in previous years and the presence of a viable seed bank that may be fairly significant in size.

As mentioned previously, variable leaf milfoil was observed in more locations throughout the lake at a later date in 2021. This illustrates the highly invasive nature of this plant and its ability to rapidly proliferate due to its many modes of reproduction. The best method of controlling variable leaf milfoil is through submerged aquatic plant treatments using herbicides. When left untreated, this plant can quickly take over a water body, decreasing water quality and value of the lake. The spread of this plant in just two seasons highlights the importance of annual aquatic plant surveys as well as aggressive herbicide treatments, as this plant can proliferate quickly making it difficult to control both physically and economically.

Stonewort was the most prevalent species found in Walker Lake in 2021, being found at 27 of the 31 survey locations in low densities. This species is not classified as a vascular plant, but macro-algae. This classification is due to the lack of a vascular system (i.e. root system) that is characteristic of plants. Instead, macro-algae consist of filaments (i.e. chains) of single cells which function independently of one another. Macro-algae do not have roots; instead they have rhizoids (root like appendages that attach to substrate). Stonewort is extremely similar to muskgrass in terms of structure and value to aquatic ecosystems which was the cause of misidentification in previous surveys. Where stonewort differs from muskgrass is that the whorled branches of stonewort are smooth and more translucent compared to muskgrass that has rigid branches. Stonewort also tends to be found in water that is more acidic which is characteristic of Walker Lake.

The next most prevalent species observed in Walker Lake were water moss which was found at 11 of the 31 sampling locations in low densities and yellow water lily which was found at 7 of the 31 locations surveyed in low densities. Water moss is a native species of submerged vegetation that provides excellent cover for fish eggs, fish fry, and many forms invertebrates like mayfly, caddisfly, and stonefly larvae. Yellow water lily is also a native species and is considered beneficial to the ecosystem at its respective density and frequency throughout the lake. Lilies provide cover and shade for fish and other aquatic life during the hot summer months. Lily beds also provide quality structure for fisherman to target while fishing for largemouth bass and other species.

Other species observed during the 2021 macrophyte survey include hairgrass, leafy pondweed, and spring tape. Hairgrass and leafy pondweed are considered native species while spring tape is not. Hair grass and leafy pondweed were found at 4 and 3 locations, respectively, and are considered beneficial to the aquatic ecosystem at their respective frequencies and densities. Spring tape should continue to be monitored as it is a non-native plant; however, this plant has not shown to be highly invasive. Refer to Attachment B for background information on all aquatic plant species that were collected in the 2017 through 2021 surveys.

3. Trend Analysis

When analyzing data sets for plant surveys that occur over the course of several years, it is important to consider several variables including timing of each survey, the life cycle of different species of plants, and treatment success. Having a thorough understanding of each of these variables and how they relate to each other is important for creating a scientifically sound lake management plan moving forward.

Aquatic plant surveys have been conducted on Walker Lake now for five consecutive years from 2017 through 2021. Each year, the timing of each survey has been slightly different. The initial survey in 2017 was conducted on June 6. By this time in the growing season, most aquatic plants are observable, especially bladderwort which was the main species of concern. In 2018, the survey was conducted early in the spring on May 3 in an effort to get started on treatments earlier in the year due to a large biomass of bladderwort that was observed in 2017. This is still very early in the growing season for floating plants to emerge and even some species of submerged aquatic plants which explains the absence of floating vegetation in the 2018 survey. In 2019, the survey was conducted on May 21 and in 2020 the survey was conducted on June 2. The results of the surveys in 2019 and 2020 were very similar, likely due to the similar timing of these surveys in relation to the life cycle of the species of plants that inhabit Walker Lake. In 2021 the survey was performed on May 26 and the results of this year's survey were very similar to previous years, with the exception of floating leaf vegetation being found at more locations.

Understanding the life cycle of each species of plant is imperative to interpreting plant survey data. Floating leaved aquatic vegetation usually takes longer to grow and reach maturity. By the end of June through mid-July, most floating leaved aquatic plants and their total respective densities and frequencies are able to be observed. This is also true for many submerged aquatic vegetation like stonewort, leafy pondweed, variable leaf milfoil, etc. Bladderwort is a slight exception as it tends to grow and reach maturity before many other species.

Evaluating treatment success becomes easier to understand when you have a thorough understanding of how the timing of each survey relates to the life cycle of each species of plant that was observed during each survey. For example, during the 2018 survey, there were no

floating leaved plants observed due to how early the survey occurred as most floating vegetation has not begun to grow yet. It was too early in the year to evaluate treatment success. From 2019 to 2020, the surveys were conducted later than 2018. As a result, some floating leaved plants were observed, indicating slightly less floating leaved aquatic vegetation observed in 2020 than 2019. Less vegetation observed in 2020 demonstrates that treatments were successful during the 2019 season. As mentioned previously, the number of floating leaf locations increased from 2020 to 2021. This could be due to several reasons including but not limited to mild spring temperatures or less aggressive floating leaf treatments in 2020. Floating leaf treatments can also vary greatly in effectiveness, mainly due to wind and wave action which washes the chemical off the surface of plants which decreases the contact time of the chemical. This in turn decreases treatment effectiveness.

Since bladderwort matures earlier in the growing season, the timing of the survey becomes less critical when determining the effectiveness of treatments conducted the previous season. In 2017, bladderwort was observed at 27 out of 31 locations. Treatments were aggressive during the 2017 season which resulted in fewer plants in 2018, with bladderwort being observed at 20 of the 31 locations in 2018, indicating successful treatments. In both 2019 and 2020, bladderwort was observed at 14 of the 31 sampling locations. Although it appears the treatments performed in 2019 were less successful than previous years, several of the locations where bladderwort was observed in 2019 were not detected at the time of the survey in 2020, indicating success in those areas where plants were absent in 2020. Also, on later site visits to Walker Lake in 2020, bladderwort was not observed at high densities, further indicating control of the species. In 2021, bladderwort was observed at just 7 of the 31 sampling locations, indicating highly successful treatments for bladderwort during the 2020 growing season. The current bladderwort population in Walker Lake is considered to be under control and not causing any water quality issues both ecologically and recreationally. However, this is a species that requires ongoing maintenance to keep the densities throughout the lake at an acceptable level.

It will be important in future surveys to try and remain consistent with timing of each survey, as this makes interpreting the results of each survey easier as it relates to the life cycle of each plant as well as treatment success. In most years, there has been an observed decrease in frequency and density of floating aquatic vegetation. Bladderwort has also generally decreased in frequency and density from 2017 to 2021.

4. Conclusions & Recommendations

Based upon our May 2021 survey, ten (10) different aquatic plants were observed throughout Walker Lake. Of these plants, six (6) are classified as submerged aquatic vegetation (SAV) and one (1) as macro-algae (MA). Variable leaf milfoil was observed once again and is considered submerged aquatic vegetation (SAV). Watershield and both white and yellow water lily are

floating aquatic vegetation (FAV). All aquatic plants identified in this 2021 survey with the exceptions of springtape and variable leaf milfoil are native to Pennsylvania. Springtape is a submerged aquatic plant which is native to Florida. Variable leaf milfoil is native to Southeastern and Midwestern United States but is becoming increasingly populated in the Northeast, threatening biodiversity and recreational value of many water bodies.

Based on the findings of the May 2021 macrophyte survey, the aquatic macrophyte community in Walker Lake could be considered fairly diverse and healthy. However, variable leaf milfoil poses a threat to the lake's ecosystem as well as recreational value of the lake. The proliferation of this plant illustrates this plants highly invasive nature and the need for continued aggressive herbicide treatments moving forward.

Based upon the above, Aqua Link offers the following recommendations to the Association to improve and protect the water quality and aquatic habitats of Walker Lake:

1. Any identified stands of variable leaf milfoil should quickly be controlled in Walker Lake in 2022. Vairable leaf milfoil, which is a non-native invasive aquatic plant, was identified for the first time in 2020. This aquatic plant was only found at 1 of the 31 monitoring stations sampled as part of the 2021 aquatic macrophye (plant) survey. Thereafter, Aqua Link targeted this plant as part of our ongoing aquatic herbicide treatment program for controlling nuisance levels of bladderwort. It should be noted that during the fishery survey in the fall of 2021, variable leaf was observed at several locations throughout the lake. This indicates the need for more aggressive and more frequent herbicide treatments for the 2022 growing season.

   Variable leaf milfoil is a nonnative invasive aquatic plant that is known for its rapid grow and outcompeting more desirable and beneficial native aquatic vegetation. If left unchecked, this aquatic plant can become dominant in shallower lakes like Walker Lake. The end result is a monoculture of variable leaf milfoil that inevitably will adversely impact lake uses (fishing, boating) and aesthetics.

   Most of the isolated stands of macrophytes (rooted aquatic plants) found in Walker Lake should be allowed to propagate and spread. Macrophytes provide habitat for aquatic organisms including fish and compete with phytoplankton (microscopic free-floating algae) for nutrients. Therefore, it is expected that increased quantities of macrophytes will further improve the water clarity of Walker Lake.

Early treatment, usually early to mid-May, is again strongly recommended for bladderwort control. A follow-up treatment should occur near the end of June through July, depending on the speed of regrowth, to treat any regrowth or additional locations not targeted in the initial treatment.

As an additional benefit, treatments for bladderwort are expected to partially keep any existing or new stands of variable leaf milfoil from becoming problematic during the spring and summer months. Floating leaved plants such as lilies and watershield should continue to be treated minimally in areas affecting water recreation or boat traffic. Some stands of lilies should be left untreated as they provide excellent habitat for fish and other aquatic organisms.

A third herbicide treatment is highly recommended during the latter part of the summer to specifically target variable leaf milfoil and prevent the spread and reproduction of this highly invasive plant.

2. Aquatic weed harvesting and the stocking of triploid grass carp are not recommended for Walker Lake. These techniques have the potential for spreading the growth of aquatic plants via fragmentation. This includes all types of aquatic weed harvesting such as manual raking/cutting or the use of commercial weed harvesting equipment. In addition, grass carp are highly unpredictable when stocked in lakes greater than 10 acres in surface area. These fish may feed primarily on native plant species as opposed to the target plant species.

3. Aquatic macrophyte surveys should be performed annually or at least on some routine basis and this is especially true since variable leaf milfoil has been identified in the lake. The purpose of these surveys is to continually monitor the lake for the spread of non-native plants that have been already identified in the lake (e.g. springtape, baby tears, and variable leaf milfoil). These surveys also will be used to assess the ongoing effectiveness of the aquatic herbicide treatment program.

4. The Association should continue collecting baseline water quality data in 2022. Newly acquired water quality data should be analyzed and compared to those data in the existing 2016 - 2021 database.

5. Fishery surveys should continue to be performed annually in Walker Lake. Newly acquired fisheries data should be analyzed and compared to those data in the existing 2016, 2017, 2019, 2020 and 2021 database.

Many of the above recommendations will require a high level of technical expertise and, therefore, likely require the professional services of a qualified environmental consultant. Aqua Link is an environmental consulting firm, specializing in lake management and restoration, and is uniquely qualified to assist the Association in implementing all of the recommendations offered in this report. In addition, the implementation of some of the recommendations may be eligible for state and federal funding. Aqua Link is highly experienced and knowledgeable in various grant programs and preparing grant applications in order to obtain state and federal funding. Over the past 23 years, Aqua Link has assisted agencies, organizations and associations in securing funds for their projects.

If you have any questions or need assistance in implementing any of the recommendations offered in this report, please call me. Thank you for allowing Aqua Link to assist you in properly managing your lake.

Sincerely,

Edward W. Molesky, Jr., CLM
President

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Attachments A & B

1577-25 Walker Lake 2021 Macrophyte Report.docx

ATTACHMENT A

Aquatic Plant Survey Field Data

Walker Lake **Macrophyte Survey** **Plant ID and Density (Low, Medium, or High)**
ALI Customer No. 1577-25
5/26/2021

Plant Common Names

WayPoint	Latitude	Longitude	Bladderwort	Watershield	Yellow Water Lily	Water Moss	Giant Hairgrass	Leafy Pondweed	Springtape	White Water Lily	Stonewort	Variable Leaf Milfoil
1	41.41177	74.92229				low		low		low	low	low
2	41.41135	74.92102										
3	41.41123	74.91986		low			low		low		low	
4	41.41237	74.91908	low		low	low					low	
5	41.41285	74.92026				low					low	
6	41.41341	74.92204				low					low	
7	41.41526	74.92082	low	low		low					low	
8	41.41487	74.91933				low					low	
9	41.41439	74.91701										
10	41.41635	74.91678										
11	41.41677	74.91750	low								low	
12	41.41774	74.91846									low	
13	41.41888	74.91714			low						low	
14	41.41846	74.91582				low					low	
15	41.41801	74.91489									low	
16	41.41933	74.91382			low						low	
17	41.41978	74.91473				low					low	
18	41.42013	74.91586									low	
19	41.42121	74.91486									low	
20	41.42092	74.91419				low						
21	41.42056	74.91352				low					low	
22	41.42151	74.91256				low					low	
23	41.42192	74.91332	low								low	
24	41.42206	74.91415			low				low		low	
25	41.42324	74.91366			low						low	
26	41.42322	74.91302	low					low			low	
27	41.42318	74.91145			low		low	low			low	
28	41.72341	74.91010					low				low	
29	41.42434	74.91322		low	low		low		low		low	
30	41.42432	74.91250	low								low	
31	41.42429	74.91196	low								low	
Count			7	3	7	11	4	3	3	1	27	1

Key to Plant Species

Common Name	Scientific Name		
Bladderwort	*Utricularia sp.*	Leafy Pondweed	*Potamogeton foliosus*
Watershield	*Brasenia schreberi*	White Water Lily	*Nymphaea sp.*
Yellow Water Lily	*Nuphar lutea*	Springtape	*Sagittaria kurziana*
Water Moss	*Fontinalis antipyretica*	Stonewort	*Nitella sp.*
Giant Hairgrass	*Eleocharis montevidensis*	Variable Leaf Milfoil	*Myriophyllum heterophyllum*

ATTACHMENT B

Aquatic Plant Descriptions & Pictures

Walker Lake

Aquatic Macrophyte Index

Bladderwort

Utricularia sp.

Alternate names—hooded watermilfoil, pop-weed

Description—A fairly common aquatic plant in Pennsylvania, bladderwort lacks true roots and often floats freely beneath the water surface. It has characteristic tiny oval bladders near the bases of finely divided leaves. It is usually found in cold ponds with acidic and soft water most prevalent in northeastern Pennsylvania. Reproduction is by winter buds. Emergent flowers are typically yellow or purple but may range to white and green. Bladderwort is especially interesting because it is carnivorous, digesting organisms such as insect larvae and zooplankton that are sucked into a trap door on each bladder. The bladders have hairs that the tiny organisms trigger as they swim.

Value—Bladderwort provides food and cover for fish. It is especially valuable because it is able to grow in acidic ponds with loose sediment where few other aquatic plants will grow.

Coontail

Ceratophyllum sp.

Alternate name -hornwort

This plant can become more of a nuisance when you are trying to control it physically or mechanically because it reproduces quickly through fragmentation.

Description - The dark olive-green leaves of coontail are whorled around the stem. Each leaflet is forked with toothed edges. The leaflets are more densely crowded around the tip of the stem, giving the appearance of a raccoon tail. The purplish green flowers form where the leaf attaches to the stem and remain submerged. The plant may be anchored to the bottom or, more likely, free-floating beneath the surface. Coontail prefers ponds with hard water, although one species can be found more commonly in softer, acidic waters. Coontail can tolerate low light conditions in deep water. Plants have been described as having a very coarse or “plastic” feeling. Coontail spreads by seeds and by fragmentation.

Value - Coontail foliage is a favorite of many species of waterfowl and muskrats in Pennsylvania. It is also home to many invertebrates such as snails, crustaceans, and insect larvae, thus providing a great source of food for fish. Coontail inhibits the growth of blue-green algae on its stems by secreting sulfur-based toxins.

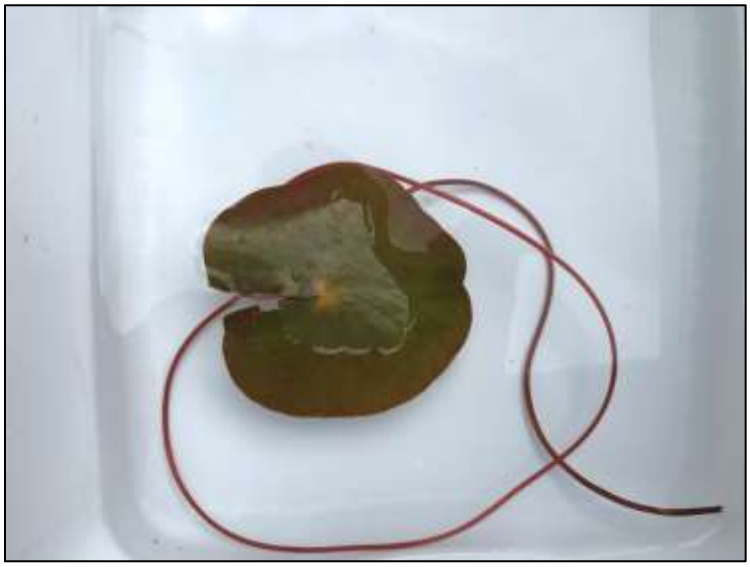
Water Lily, White

Nymphaea sp.

Alternate name - fragrant water lily

Description -Floating round leaves grow up to twelve inches across, are split to the stem in a V shape at the center, and are often purple underneath. Flowers of native water lilies are large, showy, and white, and have a sweet smell. Water lilies bearing other colored flowers are nonnative, tropical plants often sold for backyard water gardens. Flowers remain open from morning until shortly after midday. Commonly planted as an ornamental, this plant reproduces by rootstocks and seeds. It prefers to grow in quiet water less than six feet deep.

Value - This plant's beautiful appearance and its flowers make it a commonly used item in aquascapes. In addition, water lily creates excellent habitat for fish as it attracts small and large fish and their prey (insects, frogs, etc.). Despite this benefit, however, water lily's tangled stems make fishing very difficult. Waterfowl eat parts of the plant, as do a variety of wildlife, including deer. Water lily is also a favorite of honeybees.



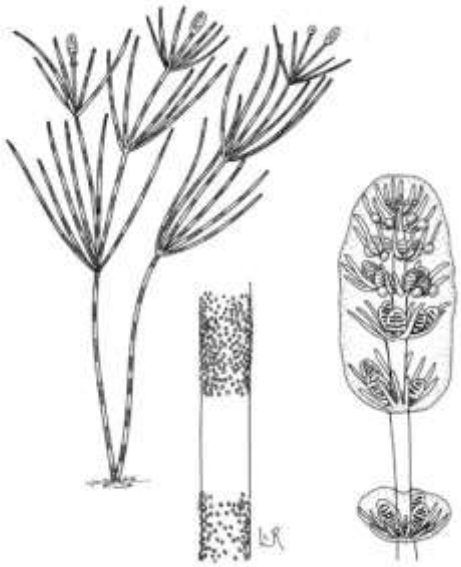
Stonewort

Nitella sp.

Description – Stonewort is classified as a macro algae, meaning it is a non-microscopic algae that can be seen with the naked eye. It has smooth stems and branches, lacking encrustation. Branches are arranged in whorls around the main stem. It is most common in soft water, especially in the Northeastern region of Pennsylvania. Stonewort is usually considered beneficial to the aquatic ecosystem.

Value – Waterfowl feed on Stonewort. It is also home to microscopic algae and invertebrates that are eaten by small fish. It is also a great source of habitat for fish.

Common look-alike – Muskgrass (*Chara)*



Watershield

Brasenia schreberi

Alternate names—dollar bonnet, dollar tag, water target

Description—Floating leaves are oval to elliptical (football shaped) and have an elastic stem that attaches at their centers. Leaves are green on top and purple underneath and grow two to five inches in length. A gelatinous coating on stems and the undersides of leaves protects them from herbivores. Flowers are dull red to purple. Plants prefer acidic and soft-water ponds and reproduce by rootstocks and seeds. Watershield can quickly take over a pond surface and severely limit recreational uses. Plants can grow in water up to six feet deep.

Value—Watershield offers good cover and habitat for fish, but the stems make fishing difficult. The leaves make a great landing spot for insects.

Yellow Water Lily

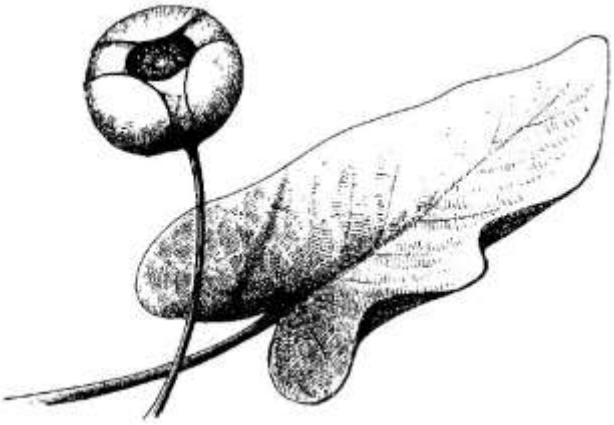
Nuphar lutea

Alternate names—yellow pond lily, cow lily, bullhead pond lily

Description—Spatterdock is common to Pennsylvania ponds, especially acidic, soft-water ponds in northern regions. It has large, twelve-inch leaves that are round to heart shaped, with a distinct midrib. Most leaves extend above the water. Flowers are large and yellowish outside and reddish inside. Spatterdock tolerates fluctuating water levels and reproduces by rootstocks and seeds.

Value—Spatterdock is an excellent plant from a wildlife and fisheries perspective. It supports a high density of fish and insect life below the water surface, providing good food and cover for fish. Large bass can often be found cruising through spatterdock looking for small fish and insects. Spatterdock is also a food source for many animals and plants.

Common look-alike—water lily



Common Water Moss

Fontinalis antipyretica

Alternate names—antifever fontinalis moss, greater water-moss

Description—*Fontinalis antipyretica* has branched, trailing stems that are triangular in cross-section and may be as long as 60 cm (24 in). The leaves are quite stiff and are arranged in three overlapping rows. Each leaf is lance-shaped or egg-shaped, with a keel and a sharp point, some 4 to 9 mm (0.16 to 0.35 in) long. There are no flowers but minute spores are sometimes produced in smooth sporangia (capsules) between 2 and 2.6 mm (0.08 and 0.10 in) long.

Value—*Fontinalis antipyretica* grows in large clumps and mats and provides refuge for fish eggs and fry. Numerous invertebrates shelter among the fronds; Chironomid larvae hide in the bases of the leaves and mayfly, caddisfly and stonefly larvae cling to the fronds, and in fast-flowing water black fly larvae are often present. Diatoms and other microscopic algae grow epiphytically on the fronds.

Muskgrass

Chara spp.

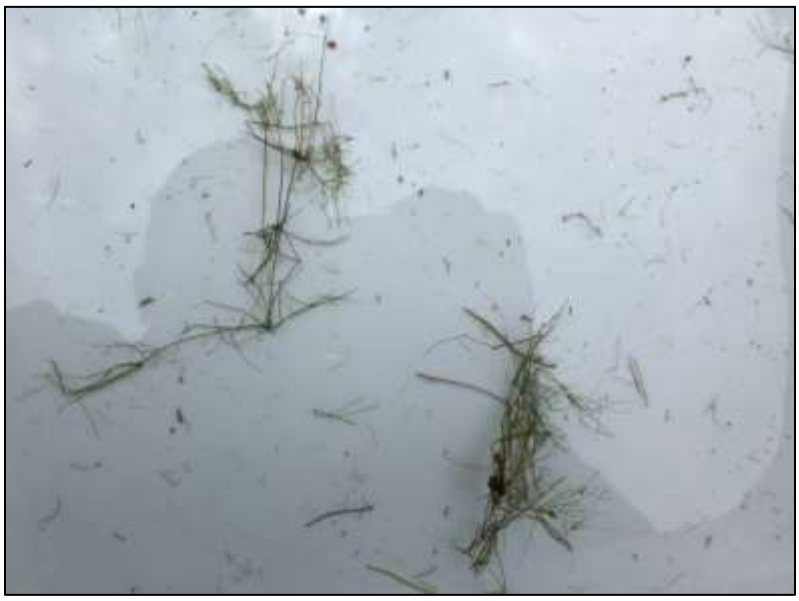
Alternate names—stoneworts, muskgrass, brittlewort, candelabra plant

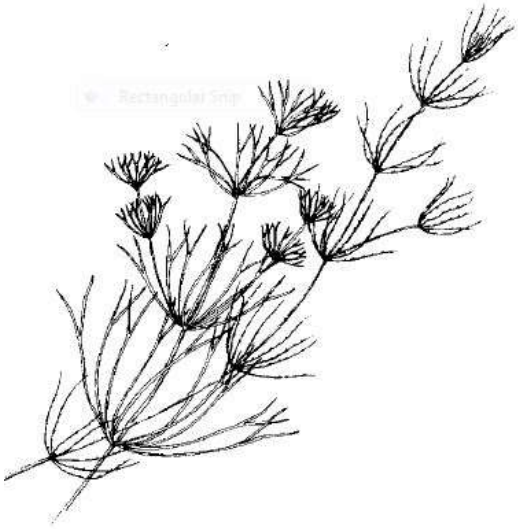
This macro algae can become more of a nuisance when you are trying to control it physically or mechanically because it reproduces quickly through fragmentation.

Description—Muskgrass is classified as algae despite looking very much like a rooted aquatic plant. It may also be classified as macro algae, non-microscopic algae that can be easily seen with the naked eye. Around the stem are whorls of six to eight "leaves," which are often encrusted with calcium carbonate. Muskgrass grows in dense mats and feels grainy or crunchy to the touch and when crushed. It produces a musty garlic or skunk like odor. It prefers soft sediment and is usually found in hard-water ponds in limestone areas of Pennsylvania.

Value—Muskgrass is an excellent food source for many species of waterfowl and various fish species. It is home to many micro- and macroinvertebrates and provides good cover for small fish. Salamanders and newts lay eggs in Muskgrass beds. Generally considered a beneficial plant, Muskgrass can become a nuisance especially in shallow ponds in hard-water regions of the state.

Common look-alike—Stonewort *(Nitella)*





Pondweed, Leafy

Potamogeton foliosus

Description—Leafy pondweed has narrow (about 1⁄ 16 inch wide), grasslike leaves. The sides of each leaf are generally parallel but form a pointed tip. There are no floating leaves. Leafy pondweed grows in many pond environments but is common in deep sediments in shallow portions of a pond, typically to a depth of four feet. Plants can grow very dense and may interfere with swimming, fishing, and boating.

Value—Leafy pondweed provides a large amount of plant material that supplies immense quantities of invertebrate food for young fish. The fruit is also eaten by many waterfowl species.

Waterweed

Elodea canadensis

Alternate names—waterweed, native *Elodea*, Canadian waterweed

This plant can become more of a nuisance when you are trying to control it physically or mechanically because it reproduces quickly through fragmentation.

Description—Waterweed is one of the most common plants in Pennsylvania ponds. It has densely whorled, dark-green leaves. The leaves usually occur in whorls of two to three that become more crowded toward the top of the stem. The dense tops can produce very thick growth near the water surface. This plant is typically rooted but can survive and grow as floating fragments. Elodea may act more like an evergreen and survive throughout the winter on a pond bottom. The flowers have three petals and are green or white. Plants reproduce from fragments.

Value—Waterweed is commonly used as an aquarium plant. Its thick stems provide cover for young fish and are home to many invertebrates that serve as a food source. The stems are also fed upon by muskrats and waterfowl. As long as it does not grow too abundantly, elodea is one of the most beneficial pond plants for its value as habitat and wildlife food, especially since it often remains green during the winter. This plant is an excellent oxygenator.

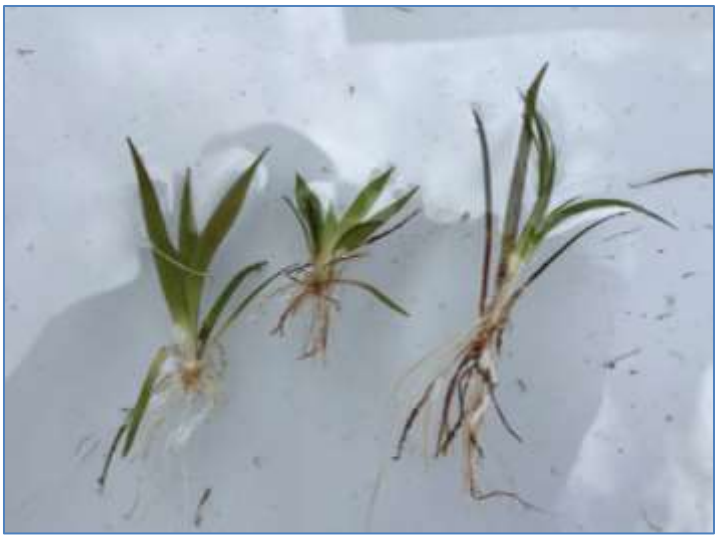
Common look-alikes—Brazilian elodea *(Egeria)*, water thyme *(Hydrilla)*

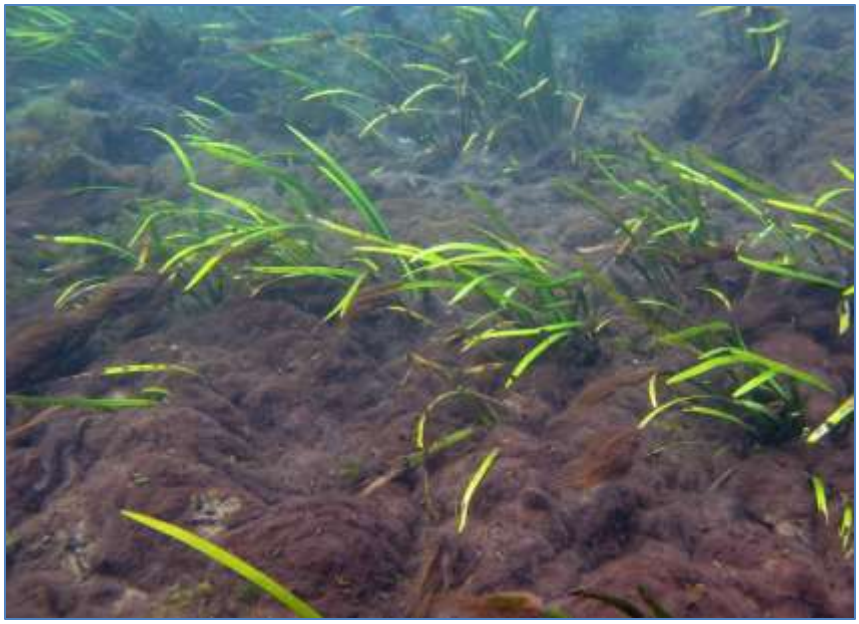
Spring Tape

Sagittaria kurziana

Description – Spring tape is a submerged, rooted plant. The leaves have pointed tips and 3-5 parallel ridges that run vertically down the leaf. The leaves range from less than an inch to 3 feet long. This plant is native to central and northern Florida, but is popular in the aquarium trade. In shallow lotic systems (flowing water) the plant will drape over the water's surface, creating a canopy to the life underneath. This plant is beneficial to an aquatic ecosystem due to its ability to create such habitat for adult and juvenile fish, crustaceans, and macro-invertebrates.

Common look alike – This plant is often confused with Tapegrass (*Vallisneria americana)*. In fact the two can be easily distinguished by one obvious trait: spring tape has pointed leaf tips while tapegrass has rounded leaf tips.





Giant Hairgrass

Eleocharis montevidensis

Description – Giant hairgrass is a species of spikesedge also known by the common name sand spikerush. It is a widespread coastal plant native to the Americas. It grows in moist, sandy spots in many habitat types, including lakes, riverbanks, wet meadows, and springs. Giant hairgrass is a rhizomatous perennial herb forming tufts or mats of erect, firm stems up to half a meter tall. The narrow grasslike leaves are dark purplish or reddish brown at the bases, becoming lighter in color toward the tips, and drying to a thin, papery texture. The inflorescence is an oval-shaped spikelet appearing at the tip of the stem. It is under a centimeter long and made up of several flowers covered in brownish bracts. This plant is beneficial to aquatic ecosystems as it provides habitat for a variety of aquatic organisms.

Variable Leaf Milfoil

Myriophyllum heterophyllum

Description - Variable leaf milfoil is a species of milfoil native to Southeastern and Midwestern United States. . This species is a submerged aquatic plant that has feather like leaves whorled around a main stem. The leaves of this plant are highly variable, containing anywhere from 5 to 14 leaflets per leaf and generally there are 4 to 6 leaves per whorl. Stands of this plant can grow to be extremely dense, with stems reaching heights of well over ten feet. Typically this plant flowers in late June to early July and produces white flowers on an emergent bract. Coloration on the plant is green with a brown to reddish hue on leaf tips. This plant can spread quickly as one of its modes of reproduction is through fragmentation in which pieces of the plant break off and form a new plant. Because of this, it can quickly out-compete native, beneficial forms of vegetation and grow in very dense stands. Variable leaf milfoil can grow to be so dense that it can substantially decrease dissolved oxygen levels and make recreational activities nearly impossible.

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